Sedentary Screen Time as a Coping Strategy of Distance Learning-induced Distress during COVID-19 Pandemic

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Abstract

During the COVID-19 pandemic, medical students might be vulnerable to excessive screen time exposure to cope with distance learning-induced distress. This study aimed to evaluate the distress and screen time before and after distance learning was initiated. Data were collected from 215 subjects. Statistical significance was accepted at $P<0.05$.The prevalence of distress among medical students was 25.61% and 27.06% before and after distance learning was executed, respectively. Academic-related stressor (ARS) was reported by 49.28% and 63.29% of students during the first and second surveys. The proportion of students with daily screen time ≥7 hours was 51.21% and 63.77% for the first and second surveys, respectively. ARS, interpersonal and intrapersonal-related stressor (IRS), social-related stressor (SRS), and average daily screen time significantly rosein 3-month-time ($P<0.0001$, $P=0.0014$, $P=0.0261$, $P=0.0022$). There was a significant association between distress and screen time ($P=0.0313$). ARS was the leading cause of distress. The majority of respondents had a daily screen time ≥7 hours. Both distress and screen time levels significantly increased as distance learning kept progressing.

Keywords: *COVID-19; distance learning; mental distress; medical students; screen time.*

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Introduction

As of July 23, 2020, Coronavirus disease 2019 (COVID-19) has become a worldwide pandemic infecting more than 14.9 million people ("WHO", 2020). It has brought a devastating impact on global health, accounting for more than 618.000 deaths across 216 countries in the world. In Indonesia, the battle against COVID-19 has started since early March, and the number of infected people keeps on rising each day, reaching more than 90.000 confirmed cases by this time ("Peta sebaran", 2020).

Currently, social distancing is actively being enforced to reduce the risk of transmission of this disease. This policy includes shutting down public places where many people are likely to gather, such as public schools. As a result, students' education has shifted from traditional 'in-person' lecture-based teaching to distance learning via online platforms (Rose, 2020).As online learning keeps on progressing, some students report that they struggled with loneliness, frustration, and boredom. They were also easily distracted and lost motivation to work (Venkatesh & Edirappuli, 2020). This can potentially lead to psychological distress (Cao et al., 2020).

The prevalence of mental distress was already high among medical students and might impair the ability to perform well throughout their studies (Melaku et al., 2015; Nivetha, et al., 2018; Yusoff, 2017). Moreover, medical students are categorized as young adults, which according to American Psychological Association (2012) showed the highest level of stress compared to other age group.It is reported that academic-related stressor was the primary source of stress among medical students (Melaku et al., 2015; Mudor & Mudor, 2015; Nivetha, Ahmed, & Prashantha, 2018; Patil et al., 2017). Other potential causes of mental discomfort included interpersonal and intrapersonal-related stressors, teaching and learning-related stressors, social-related stressors, drive and desire-related stressors, and group activities-related stressors (Yusoff et al., 2010).

After confronted with stressful events or environments, some individuals might increase their screen time as a way to find salvation and get emotional support (Khalili-Mahani et al., 2019; Wang et al., 2015; Xu et al., 2019). However, excessive screen time has shown

adverse effects on physical and emotional well-being, including internet addiction (Lissak, 2018; Madhav et al., 2017; Twenge & Campbell, 2018).Prolonged distance learning during COVID-19 pandemic may have detrimental effects on mental health. As a result, medical students are probably more vulnerable to excessive screen time exposure.To the best of our knowledge, no studies had been conducted among medical students to assess the extent of stress during distance learning and whether screen time could be a strategy to cope with the distress. By knowing this, we can make some recommendation for students related to screen time and mental health to decrease mental health problems among medical students. Hence this paper aims to assess the relationship and compare the level of stress and screen timebefore and after distance learning was initiated.

Methods

This cross-sectional study was conducted from February to May 2020, at the School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia. Ethical approval was obtained from the Ethical Review Committee of School of Medicine and Health Sciences – Atma Jaya Catholic University of Indonesia (No: 04/06/KEP-FKUAJ/2020).

Medical students who had given their consent were eligible for this study. Subjectswere excluded from the study if they meet any of these following: diagnosed with mental disorders or currently consumed psychotropic medications.The minimal sample size required for this study was calculated using the single population proportion formula with 95% CI, 5% margin of error, and 50% of the prevalence of stress (Charan & Biswas, 2013). Considering dropout and design error, the sample size was increased up to 215 students.First, to select a sample,proportional stratified sampling was used based on the year of study. As many as 70 subjects from each year batch were recruited and further selected using simple random sampling. Randomization was done using random number generator software, which was adjusted to the names list of students from each year of study. Data collection was done twice with a three-month interval (February and May

2020). Self-administered questionnaires were distributed online alongside with informed-consent form.

Measurements

Data measurement was done using questionnaires consisting of three sections: (1) sociodemographics, (2) screen time questionnaire; (3) Medical Students Stressor Questionnaire (MSSQ); and (4) Depression, Anxiety, and Stress Scale-21 (DASS-21). Length of participants' screen time was measured with built-in *Screen Time* application for iOs users and *Screen Time – Restrain Yourself & Parental Control* version 2.2.1 (*Iridium Dust Limited*) for non-iOs users. Average daily usage was calculated. Collected data was categorized into daily screen time ≥7 hours and<7 hours.

MSSQ was used to identify the potential stressors and assess the severity of stress. The tool consisted of 40 items representing six domains of stressors, including academic-related stressor (ARS), interpersonal and intrapersonal-related stressor (IRS), social-related stressor (SRS), teaching and learning-related stressor (TLRS), drive and desire-related stressor (DRS), and group activities-related stressor (GARS). Participants were asked to rate the severity of stress during the last 7 days in a 5-point-likert scale.The mean scores for each domain were calculated, which ranged between 0-4. A mean score of 0-1.00 indicated mild stress, 1.01-2.00 indicated moderate stress, 2.01-3.00 indicated high stress, and 3.01-4.00 indicated severe stress (Yusoff et al., 2010).The stress level was later recategorized as normal (mild and moderate stress) and abnormal (high and severe stress).Pearson product moment validity test showed a statistically significant (P<0.05) item-total correlation ranging from 0.39 to 0.76 confirming the good discrimination of each question and the suitability of MSSQ for measuring and obtaining data from respondents in this study. Cronbach's Alpha reliability test also showed significance value more than 0.90 confirming the internal consistency of MSSQ when used repeatedly.Validation of this instrument was also done on the medical student across study year and across medical schools in various countries which was acceptable on content, response process, internal

structure, relations to other variables, and consequences of its score (Yusoff, 2011, 2013, 2017).

DASS-21was used to measure emotional distress in general consisting of difficulty relaxing, nervous arousal, and being easily upset/agitated, irritable/over-reactive, and impatient. Stress scale contained 7 items in which participants were asked to rate how frequent they experienced each state over the last 7 days in a 4-point-likert scale with a maximum score of 42. A score of 0-14 indicated normal, 15-18 indicated mild stress, 19-25 indicated moderate stress, 26-33 indicated severe stress, and 28-42 indicated extremely severe stress. Pearson product moment validity test showed a statistically significant (P<0.05) item-total correlation for stress scale (item no. 1,6,8,11,12,14,18) ranging from 0.44 to 0.79 confirming the good discrimination of each question and the suitability of DASS-21 for measuring and obtaining distress data from respondents in this study. Cronbach's Alpha reliability test also showed significance value more than 0.90 confirming the internal consistency of DASS-21 when used repeatedly (Supplementary Figure 2).Validity and reliability of this instrument were acceptable and further confirmed in a worldwide study using individuals with various races (Lovibond & Lovibond, 1995; Norton, 2007).

Data analysis

Data were analyzed using Stata Statistical Software: Release 12 (2011) (*Stata Statistical Software: Release 12*, 2011). Distribution of data was assessed by using Shapiro Wilk normality test. Depends on the result, either dependent sample *T*-test or Wilcoxon signed-rank test would be used to analyze whether there was significant differences of level of stress and screen time before and after distance learning was executed. Bivariate analysis using Chi-square andKendall's rank correlation was also done to assess the association between the level of stress and duration of screen time. Statistical significance was accepted at P<0.05.

Results

Two hundred fifteen students were selected for this study. The response rate during the first survey was 100.0%. However, during the second survey, only 214 students participated and completed the questionnaire, giving an overall response rate of 99.5%. One person was excluded because he was absent throughout the second survey. Then, 7 out of 214 students were further excluded, for they had a history of mental disorders or consuming psychotropic medications. The final sample used for this study was 207 respondents.

Age of 207 respondents ranged from 16 to 22 years (Mean:19.22±1.03). The majority of respondents were female (69.57%) and 3rd-year medical students(34.78%). Concerning ethnicity and religion, most of the respondents were Chinese (73.43%) and Catholic (39.61%).The prevalence of distress among medical students was 25.61% and 27.06% before and after distance learning was executed, respectively. The later was higher, although it was not statistically significant (*P*=0.1514). As shown in Table 1, students aged 19 years old and above were more likely to experience distress compared to youngerstudents, even though the difference was not statistically significant (*P*=0.057, *P*=0.490). Distress was more prominent among female compared to male students in both conditions, but it was not statistically significant (*P*=0.518, *P*=0.237). Before distance learning was implemented, the highest prevalence of distress was observed among 1st year medical students (32.81%). On the contrary, 3rd year medical students showed the highest level of distress after distance learning was executed (27.78%), even though the difference was not statistically significant in both conditions (*P*=0.204, *P*=0.920). Neither ethnicity (*P*=0.721, *P*=0.520) nor religion (*P*=0.570, *P*=0.621) has significant association with distress.

Table 1.
Association between Stress and Sociodemographic Variables among Medical Students.

Sociodemographic Variables	Total, N (%)	Distress: Before Distance Learning (February) Yes (n=53) N (%)	Before Distance Learning (February) No (n=154) N (%)	*P* value	After Distance Learning (May) Yes (n=54) N (%)	After Distance Learning (May) No (n=153) N (%)	*P* value
Age							
16-18	50 (24.15)	12 (24.00)	38 (76.00)	0.057	10 (20.00)	40 (80.00)	0.490
19	71 (34.30)	25 (35.21)	46 (64.79)		21 (29.58)	50 (70.42)	
20-22	86 (41.55)	16 (18.60)	70 (81.40)		23 (26.74)	63 (73.26)	
Gender							
Male	63 (30.43)	18 (28.57)	45 (71.43)	0.518	13 (20.63)	50 (79.37)	0.237
Female	144 (69.57)	35 (24.31)	109 (75.69)		41 (28.47)	103 (71.53)	
Academic Year							
1st Year	64 (30.92)	21 (32.81)	43 (67.19)	0.204	16 (25.00)	48 (75.00)	0.920
2nd Year	71 (34.30)	18 (25.35)	53 (74.65)		18 (25.35)	53 (74.65)	
3rd Year	72 (34.78)	14 (19.44)	58 (80.56)		20 (27.78)	52 (72.22)	
Ethnicity							
Chinese	152 (73.43)	40 (26.32)	112 (73.68)	0.721	37 (24.34)	115 (75.66)	0.520
Javanese	26 (12.56)	5 (19.23)	21 (80.77)		7 (26.92)	19 (73.08)	
Others	29 (14.01)	8 (27.59)	21 (72.41)		10 (34.48)	19 (65.52)	
Religion							
Catholic	82 (39.61)	24 (29.27)	58 (70.73)	0.570	22 (26.83)	60 (73.17)	0.621
Christian	69 (33.33)	17 (24.64)	52 (75.36)		20 (28.99)	49 (71.01)	
Others	56 (27.05)	12 (21.43)	44 (78.57)		12 (21.43)	44 (78.57)	

Note: Statistical significance indicated in bold.

Before distance learning was implemented, most students (49.28%) considered ARS as the source of high-to-severe stress in medical schools. SRS (33.33%) and IRS (31.40%) were the second and third causes of stress among medical students, respectively. Based on the mean score of each domain, ARS was the source of high stress (2.00±0.69), followed by IRS (1.70±0.89) and SRS (1.70±0.68). ARS was also the leading cause of stress on medical

students after distance learning was executed. It is reported that 131 out of 207 students (63.29%) had high-to-severe academic-related stress levels. The second and third leading cause of stress reported was IRS (42.03%) and TLRS (31.88%), respectively. According to the mean score of each domain,ARS remained the main source of high stress (2.21±0.75), followed by IRS (1.89±0.97) and SRS (1.80±0.72).All of the stressor domains showed an increase in stress levelafter distance learning was implemented (Table 2). However, only 3 out of 6 stressor domains had a statistically significant change of stress level, which included ARS (P<0.0001), IRS (P=0.0014), and SRS (P=0.0261).

Before distance learning was executed, the proportion of students with average daily screen time ≥7 hours was 51.21%, with a mean score of 7.34 (SD=2.55). There was an increase in the number of students with screen time ≥7 hours per day after the implementation of distance learning, reaching as many as 132 out of 207 students (63.77%). The mean score of the daily screen time of the second survey was 7.91 (SD=2.87). The rise of average daily screen time during the second survey was statistically significant compared to the first survey (P=0.0022).

Kendall's tau-b correlation was run to assess the relationship between stress level and screen time in medical students. Even though no significant correlation between two variables was observed before distance learning was implemented (τb=-0.0096, P=0.8624), however, there was weak, positive correlation between stress level and screen time after distance learning was executed, which was statistically significant (τb=0.1186, P=0.0313).Chi-square analysis was run to determine the association between various stressors and screen time (Table 3). Before distance learning was implemented, most students with the high-to-severe level of TLRS, SRS, and DRS had increased screen time. The proportion of distressed-students with average daily screen time ≥7 hours was 52.63% for TLRS, 52.17% for SRS, and 56.52% for DRS. However, the association observed between TLRS, SRS, DRS, and screen time was not statistically significant (P=0.801, P=0.844, P=0.414, respectively).

Table 2.
Sources of Distress among Medical Students.

Medical Students Stressor Questionnaire (MSSQ)	Before Distance Learning (February) Frequency N (%)	Mean±SD	After Distance Learning (May) Frequency N (%)	Mean±SD	*P*value
ARS					
Mild	16 (7.73)	2.00±0.69	13 (6.28)	2.21±0.75	**0.0000**[*]
Moderate	89 (43.00)		63 (30.43)		
High	87 (42.03)		108 (52.17)		
Severe	15 (7.25)		23 (11.11)		
IRS					
Mild	52 (25.12)	1.70±0.89	48 (23.19)	1.89±0.97	**0.0014**[*]
Moderate	90 (43.48)		72 (34.78)		
High	50 (24.15)		63 (30.43)		
Severe	15 (7.25)		24 (11.59)		
TLRS					
Mild	59 (28.50)	1.61±0.78	45 (21.74)	1.67±0.78	0.2086[†]
Moderate	91 (43.96)		96 (46.38)		
High	51 (24.64)		57 (27.54)		
Severe	6 (2.90)		9 (4.35)		
SRS					
Mild	41 (19.81)	1.70±0.68	36 (17.39)	1.80±0.72	**0.0261**[†]
Moderate	97 (46.86)		108 (52.17)		
High	66 (31.88)		54 (26.09)		
Severe	3 (1.45)		9 (4.35)		
DRS					
Mild	87 (42.03)	1.47±0.94	82 (39.61)	1.48±0.93	0.5363[*]
Moderate	74 (35.75)		79 (38.16)		
High	35 (16.91)		36 (17.39)		
Severe	11 (5.31)		10 (4.83)		
GARS					
Mild	61 (29.47)	1.66±0.84	49 (23.67)	1.74±0.86	0.1292[†]
Moderate	86 (41.55)		96 (46.38)		
High	49 (23.67)		47 (22.71)		
Severe	11 (5.31)		15 (7.25)		

Abbreviation: ARS: Academic-related Stressor; DRS: Drive and Desire-related Stressor;GARS: Group Activities-related Stressor; IRS: Interpersonal and Intrapersonal-related Stressor; SRS: Social-related Stressor; TLRS: Teaching and Learning-related Stressor; Note: [*] Wilcoxon sign-ranked test, [†] Dependent *T* test; Statistical significance indicated in bold

Other stressor domains, such as ARS, IRS, and GARS, showed a relatively lower or similar proportion of distressed- students with screen time ≥7 and <7 hours per day. Also, no significant association was observed between these stressors domains and screen time (*P*=0.732, *P*=0.494, *P*=0.404, respectively). All of the stressors domains showed an increased number of distressed-students with daily screen time ≥7 hours after distance learning was executed. Increased screen time was observed among students with high-to-severe level stress caused by ARS (61.83%), IRS (59.77%), TLRS (63.64%), SRS (57.14%),

DRS (65.22%), and GARS (69.25%). However, this high screen time level does not show statistically significant association with the stress occurring among students (*P*=0.447, *P*=0.308, *P*=0.978, *P*=0.190, *P*=0.817, *P*=0.274, respectively).

Table 3.
Association between Various Stressors and Screen Time among Medical Students.

	Screen Time					
	Before Distance Learning (February)			After Distance Learning (May)		
Distress	≥ 7 hours/day N (%)	<7 hours/day N (%)	*p*value	≥ 7 hours/day N (%)	<7 hours/day N (%)	*p* value
ARS						
Yes	51 (50.00)	51 (50.00)	0.732	81 (61.83)	50 (38.17)	0.447
No	55 (52.38)	50 (47.62)		51 (67.11)	25 (32.89)	
IRS						
Yes	31 (47.69)	34 (52.31)	0.494	52 (59.77)	35 (40.23)	0.308
No	75 (52.82)	67 (47.18)		80 (66.67)	40 (33.33)	
TLRS						
Yes	30 (52.63)	27 (47.37)	0.801	42 (63.64)	24 (36.36)	0.978
No	76 (50.67)	74 (49.33)		90 (63.83)	51 (36.17)	
SRS						
Yes	36 (52.17)	33 (47.83)	0.844	36 (57.14)	27 (42.86)	0.190
No	70 (50.72)	68 (49.28)		96 (66.67)	48 (33.33)	
DRS						
Yes	26 (56.52)	20 (43.48)	0.414	30 (65.22)	16 (34.78)	0.817
No	80 (49.69)	81 (50.31)		102 (63.35)	59 (36.65)	
GARS						
Yes	28 (46.67)	32 (53.33)	0.404	43 (69.35)	19 (30.65)	0.274
No	78 (53.06)	69 (49.94)		89 (61.38)	56 (38.62)	

Abbreviation: ARS: Academic-related Stressor; DRS: Drive and Desire-related Stressor;GARS: Group Activities-related Stressor; IRS: Interpersonal and Intrapersonal-related Stressor; SRS: Social-related Stressor; TLRS: Teaching and Learning-related Stressor.

Discussion

The prevalence of mental distress was already high among medical students, ranging from20% to 52.4% (Melaku et al., 2015; Nivetha M. et al., 2018). In the present study, the prevalence of distress among medical students was 25.61% and 27.06% before and after distance learning was executed, respectively. Another study by Hill et al. (2018) showed as many as 68.6% of medical students had significant but manageable distress, while 11.2%

experienced severe and debilitating distress. The variability in the distress level might be due to differences in curricula, teaching and learning facilities, qualification of lecturers,and level of care given to the students. Other possible reasons were differences in college environment, regional socio-cultural factors, and diagnostic instruments.

Gender was not related to distress. Previous studies had showed similar results (Melaku et al., 2015; Mudor & Mudor, 2015; Nivetha. et al., 2018), except in one study by Chen et al. (2013).Our study also showed that age was not associated to distress level and in accordance with a study by Melaku et al. (2015), even thoughthe present study produced similar results in which older students were more likely to experience distress (Nivetha M. et al., 2018). Before distance learning was initiated, the prevalence of distress was decreasing as the year of study increased, in accordance with a study by Melaku et al. (2015). This might be due to gradual adjustment to the learning environment, in which first year medical students had yet to adapt with the medical training they currently receiving, while senior students might have develop skills and strategies to manage their medical education. However, after distance learning was executed, final year of pre-clinical students showed the highest prevalence of distress. Chen et al. (2013) showed that fifth year medical students had the highest level of distress. A possible explanation was that senior students had entered transition phase from pre-clinical to clinical clerkshipand had to prepare for objective structured clinical assessment (OSCA). COVID-19 pandemic had disrupted students getting adequate on-hands basic practical skills for the upcoming clerkship which might contribute to higher level of distress in final year pre-clinical students. However, this study did not show significant association between academic year and distress level. Similar to previous studies, ethnicity andreligion were not associated with distress level (Melaku, et al., 2015; Nivetha, et al., 2018).

ARS was the primary cause of high-to-severe stress among medical students before and after distance learning was executed (49.28% and 63.29%, respectively). A similar survey by Nivetha et al. (2018) also showed that 40.9% of students considered ARS as the source of high stress. Another study by Melaku et al. (2015) found that 60.3% of students had a high-to-severe level of stress caused by ARS.The mean score of ARS in this study was 2.00±0.69 initially and 2.21±0.75 in three-month after distance learning was executed. The finding was

similar to a previous studywhich showed a mean score of 2.19±0.64 for ARS (Mudor & Mudor, 2015). Another studyby Patil et al. (2017) hadshowed a mean score of 1.61±0.88 for ARS. These findings were related to the facts that medical students might be pressurized because of the overwhelming amount of materials to be mastered, complexity of the syllabus, frequent examinations, unnecessary workloads, low academic perfomance andcompetitive learning environment (Hill et al., 2018; Yusoff et al., 2017).

In general, the level of distress before and after the implementation of distance learning were similar. To the best of our knowledge, no study had been conducted in medical students to evaluate the impact of distance learning to psychological distress. However, a study with a general population in China also showed similar levels of distress when the new cases of COVID-19 rapidly increased. Yet, this study supported the fact that prolonged social quarantine had adverse impacts on mental health, especially in the 12-21.4-year-old group which was primarily affected by extended school closure, requiring online education assistance and uncertainty about examinations and matriculation arrangements (Wang et al., 2020). The significant rise of stress level before and after the initiation of distancelearning were only observed in stress caused by ARS, IRS, and SRS. Increased in ARS was probably due to students' difficulty understanding the lessons through online classes, abundant assessments, and lacking medical skill practice (Sahu, 2020). Increased in IRS and SRS might be associated with the change of students' learning environment from a standard classroom to online learning at home. Being socially-confined, some students report that they struggle with loneliness, frustration, and boredom. They are also easily distracted and lose motivation to work (Venkatesh & Edirappuli, 2020).

This study also showed that the proportion of students with daily screen time ≥7 hours was 51.21% in the early phase and 63.77% in three months after distance learning was initiated. This number was higher than the previous study done by Kleppang et al. (2019)in which the proportion of adolescents aged 15-16 with sedentary screen time ≥6 hours per day was 32%. Another studyreported the proportion of adults aged 20 and above with daily screen time >6 hours was 14.75% (Madhav et al., 2017). Nonetheless, the average daily screen time in this study was 7.34 and 7.91 hours before and after the execution of distancelearning, respectively. This result was in accordance with a survey in 2019 by

Common Sense Media which revealed that the average daily screen time of adolescents aged 13-18 years old was 7 hours 22 minutes ("The Common Sense Census", 2020). The duration of daily screen time significantly increased in the second survey compared to the first one. This was probably related to the students' using the online learning platform and self-study in the middle of the pandemic, besides screen time for social and entertainment purposes (Sahu, 2020).

It was worth noting that the daily screen time observed among medical students was very high. Dalle et al. (2015) recommended that screen time should not exceed 2 hours per day for adolescents aged 6-18 years old.Longer screen time was associated with several adverse effects. Individuals with daily screen time >2-4 hours were associated with obesity, increased blood pressure, and impaired sleep quality. Moreover, excessive screen time exposure could lead to vision impairement, dizziness, and discomfort in some parts of the body (Lissak, 2018). To some extent, people with longer screen time were 4.68 times more likely to experience internet addiction (Asut et al., 2019).

Longer screen time was also associated with psychological disorders. In the present study, there was weak, positive correlation between distress and screen time, especially after distance learning was implemented. This finding was in accordance withstudies conducted by Xu et al. (2019) and Wang et al. (2015) that revealed that a higher level of stress was associated with excessive use of smartphones.Moreover, another study by Kleppang et al. (2019) found that adolescents with screen time ≥6 hours per day were 1.721 times more likely to suffer from psychological distress. The weak correlation could be explained by the possibility of other coping strategies used by the students, such as sleeping, listening to music, dancing, talking with friends/family, self-evaluation, etc (Nivetha, Ahmed, & Prashantha, 2018). Other possibility includes the fact that some medical students fail to cope with the distress they currently experienced. Medical students are categorized as young adults, which showed the highest percentage of having difficulty in managing their stress (American Psychological Association, 2012). In this study, we group high and severe stress as abnormal, where this high level of stress leads to mental disorder. Mental disorder happens when the coping strategy, to maintain stress, fails. We can assume that the participants that belong to the abnormal stress group already have mental disorder so

they cannot use their coping strategy, for example increasing their screen time to find salvation, because they do not have anyinterests in pleasant activities.

As far as our knowledge, this was the first study conducted in medical students to evaluate the level of stress and screen time before and after distance learning. Data from this study suggested high level of distress caused by different stressors and daily screen time before and after distance learning was initiated. Our study implied that medical students had risks of experiencing the detrimental impacts of high level of distress and screen time. Healthcare authorities may gain insight on the current mental health status of the students and thus giving appropriate treatment if there is a decline on mental health or impairment in the quality of life. In addition, our study was conducted on the same subjects at three-month interval hence making the findings more objective and reliable. However, this study has some limitations. Subjects only included medical students enrolled in the School of Medicine and Health Sciences Atma Jaya Catholic University of Indonesia. Thus findings from this study might show differences in a general setting.This study mainly focused on stressors commonly observed in medical studies and did not take into account other potential stressors during social distancing period, such as low knowledge about COVID-19, improper precautionary measures, and concerns about other family members getting the disease.

Conclusion

Academic-related stressor was the leading cause of stress among medical students. More than half of the respondents had daily screen time ≥7 hours. The level of stress and screen time significantly increased in three-month after distance learning was implemented. There was significant correlation between stress and screen time.We could assume that medical students have increased risk of physical and psychological adverse events after excessive stress and screen time exposure.

Author Contributions

Conceptualization and Methodology: GM (Ghea Mangkuliguna, M (Mahaputra), VMS (Veronika M. Sidharta), LH (Linawati Hananta); Data Acquisition: GM; Formal Analysis: GM, M, VMS, M; Writing – Original Draft: GM, M; Writing – Review and Editing: M, VMS, LH; Final Approval: GM, M, VMS, LH.

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References

American Psychological Association. (2012). *Stress by generations: 2012*. https://www.apa.org. Retrieved October 16, 2020, from https://www.apa.org/news/press/releases/stress/2012/generations

Asut, O., Abuduxike, G., Acar-Vaizoğlu, S., & Cali, S. (2019). Relationships between screen time, internet addiction and other lifestyle behaviors with obesity among secondary school students in the Turkish Republic of Northern Cyprus. *The Turkish Journal of Pediatrics*, *61*, 568. https://doi.org/10.24953/turkjped.2019.04.014

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research*, *287*, 112934–112934. https://doi.org/10.1016/j.psychres.2020.112934

Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*, *35*(2), 121–126. PubMed. https://doi.org/10.4103/0253-7176.116232

Chen, J. , Wu, Y. , Yi, H. , Li, Z. , Eshita, Y. , Qin, P. , Chen, L. and Sun, J. (2013) The impact of academic stress on medical students attending college in the Inner Mongolia Area of China. *Open Journal of Preventive Medicine*, 3, 149-154. doi: 10.4236/ojpm.2013.32019

Dalle, J., Mutalib, A. A., Saad, A. L., Ayub, M. N., Wahab, A. W. A., & Nasralla, A. M. H. (2015). Usability considerations make digital interactive book potential for inculcating interpersonal skills. *Jurnal Teknologi*, 77(29), 156-169. https://doi.org/10.11113/jt.v77.6837

Hill, M. R., Goicochea, S., & Merlo, L. J. (2018). In their own words: Stressors facing medical students in the millennial generation. *Medical Education Online*, *23*(1), 1530558. https://doi.org/10.1080/10872981.2018.1530558

Khalili-Mahani, N., Smyrnova, A., & Kakinami, L. (2019). To each stress its own screen: A cross-sectional survey of the patterns of stress and various screen uses in relation to self-admitted screen addiction. *Journal of Medical Internet Research*, *21*(4), e11485. https://doi.org/10.2196/11485

Kleppang, A. L., Thurston, M., Hartz, I., & Hagquist, C. (2019). Psychological distress among Norwegian adolescents: Changes between 2001 and 2009 and associations with leisure time physical activity and screen-based sedentary behaviour. *Scandinavian Journal of Public Health*, *47*(2), 166–173. https://doi.org/10.1177/1403494817716374

Lissak, G. (2018). Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. *Environmental Research*, *164*, 149–157. https://doi.org/10.1016/j.envres.2018.01.015

Lovibond, S.H. & Lovibond, P.F. (1995). *Manual for the Depression Anxiety Stress Scales* (2nd. Ed.). Sydney: Psychology Foundation.

Madhav, K. C., Sherchand, S. P., & Sherchan, S. (2017). Association between screen time and depression among US adults. *Preventive Medicine Reports*, *8*, 67–71. PubMed. https://doi.org/10.1016/j.pmedr.2017.08.005

Melaku, L., Mossie, A., & Negash, A. (2015). Stress among medical students and its association with substance use and academic performance. *Journal of Biomedical Education*, *2015*, 9. https://doi.org/10.1155/2015/149509

Mudor, N., & Mudor, A. (2015). *Stress among medical students in the deep south of Thailand* (No. 2803508; Proceedings of International Academic Conferences). International Institute of Social and Economic Sciences. https://ideas.repec.org/p

Nivetha M., B., Ahmed, M., &Prashantha, B. (2018). Perceived stress and source of stress among undergraduate medical students of Government Medical College, Mysore.

International Journal of Community Medicine and Public Health, *5*(8). https://dx.doi.org/10.18203/2394-6040.ijcmph20183090

Norton P. J. (2007). Depression Anxiety and Stress Scales (DASS-21): psychometric analysis across four racial groups. *Anxiety, stress, and coping*, 20(3), 253–265. https://doi.org/10.1080/10615800701309279

Patil, S. P., Sadhanala, S., Srivastav, M. U., & BansodeGokhe, S. S. (2017). Study of stressors among undergraduate medical students of a teaching medical institution. *International Journal of Community Medicine and Public Health; Vol 4, No 9 (2017): September 2017*. https://doi.org/10.18203/2394-6040.ijcmph20173655

Peta sebaran | Gugus tugas percepatan penanganan COVID-19. covid19.go.id. Retrieved May 28, 2020, from https://covid19.go.id/peta-sebaran

Rose, S. (2020). Medical student education in the time of COVID-19. *JAMA*. https://doi.org/10.1001/jama.2020.5227

Sahu, P. (2020). Closure of universities due to coronavirus disease 2019 (COVID-19): Impact on education and mental health of students and academic staff. *Cureus*, *12*(4), e7541–e7541. PubMed. https://doi.org/10.7759/cureus.7541

Stata Statistical Software: Release 12 (Version 12). (2011). [computer software]. StataCorp LP.

The Common Sense Census: Media Use by Tweens and Teens, 2019 | Common Sense Media. Retrieved October 11, 2020, from https://www.commonsensemedia.org/research

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, *12*, 271–283. PubMed. https://doi.org/10.1016/j.pmedr.2018.10.003

Venkatesh, A., & Edirappuli, S. (2020). Social distancing in covid-19: What are the mental health implications? *BMJ*, *369*, m1379. https://doi.org/10.1136/bmj.m1379

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., Choo, F. N., Tran, B., Ho, R., Sharma, V. K., & Ho, C. (2020). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, Behavior, and Immunity*, *87*, 40–48. https://doi.org/10.1016/j.bbi.2020.04.028

Wang, J.-L., Wang, H.-Z., Gaskin, J., & Wang, L.-H. (2015). The role of stress and motivation in problematic smartphone use among college students. *Computers in Human Behavior*, *53*, 181–188. https://doi.org/10.1016/j.chb.2015.07.005

WHO coronavirus disease (COVID-19) dashboard. Retrieved July 24, 2020, from https://covid19.who.int/

Xu, T.-T., Wang, H.-Z., Fonseca, W., Zimmerman, M. A., Rost, D. H., Gaskin, J., & Wang, J.-L. (2019). The relationship between academic stress and adolescents' problematic smartphone usage. *Addiction Research & Theory*, *27*(2), 162–169. https://doi.org/10.1080/16066359.2018.1488967

Yusoff, M. S. B. (2011). A Multicenter Study on Validity of the Medical Student Stressor Questionnaire (MSSQ). *International Medical Journal (1994)*, *18*, 14–18.

Yusoff, M. S. B. (2013). The stability of MSSQ to measure stressors among medical students. *International Medical Journal (1994)*, *20*, 1–3.

Yusoff, M. S. B. (2017). A systematic review on validity evidence of medical student stressor questionnaire. *Education in Medicine Journal*, *in press*. https://doi.org/10.21315/eimj2017.9.1.1.

Yusoff, M. S. B., Fuad, A., & Yaacob, M. J. (2010). The development and validity of the medical student stressor questionnaire (MSSQ). *ASEAN Journal of Psychiatry*, *11*.

Appendices

Supplementary Figure 1. *Validity and Reliabity of Medical Students Stressor Questionnaire (MSSQ). (a) Before Distance Learning (February) and (b) After Distance Learning (May).*

Pearson product moment validity test showed a statistically significant ($P<0.05$) item-total correlation ranging from 0.39 to 0.76 confirming the good discrimination of each question and the suitability of MSSQ for measuring and obtaining data from respondents in this study. Cronbach's Alpha reliability test also showed significance value more than 0.90 confirming the internal consistency of MSSQ when used repeatedly.

(a) Before Distance Learning (February)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem cov.	alpha	Label
feb_mssq_s~t	207	+	0.5660	0.5437	.402471	0.9557	
var75	207	+	0.6051	0.5808	.3989339	0.9555	
var76	207	+	0.6745	0.6556	.3985045	0.9552	
var77	207	+	0.5809	0.5545	.3990458	0.9556	
var78	207	+	0.5410	0.5136	.4007887	0.9558	
var79	207	+	0.6054	0.5812	.3989269	0.9555	
var80	207	+	0.5952	0.5690	.398193	0.9555	
var81	207	+	0.5642	0.5355	.3986842	0.9557	
var82	207	+	0.6642	0.6416	.3959685	0.9551	
var83	207	+	0.6535	0.6277	.3941485	0.9552	
var84	207	+	0.6029	0.5775	.3982762	0.9555	
var85	207	+	0.7259	0.7067	.3937901	0.9548	
var86	207	+	0.6609	0.6386	.3965479	0.9552	
var87	207	+	0.6723	0.6482	.3939529	0.9551	
var88	207	+	0.6800	0.6547	.3921959	0.9550	
var89	207	+	0.6654	0.6408	.3941233	0.9551	
var90	207	+	0.6595	0.6348	.394553	0.9551	
var91	207	+	0.5481	0.5183	.3990138	0.9558	
var92	207	+	0.5894	0.5617	.3976134	0.9556	
var93	207	+	0.6201	0.5952	.3974456	0.9554	
var94	207	+	0.6352	0.6104	.3964311	0.9553	
var95	207	+	0.7160	0.6974	.3954165	0.9549	
var96	207	+	0.6010	0.5767	.3991926	0.9555	
var97	207	+	0.5186	0.4863	.3995164	0.9560	
var98	207	+	0.6219	0.5962	.3967318	0.9554	
var99	207	+	0.6286	0.6008	.3946795	0.9554	
var100	207	+	0.5585	0.5274	.3976509	0.9558	
var101	207	+	0.5963	0.5641	.3942034	0.9556	
var102	207	+	0.5520	0.5189	.3969578	0.9559	
var103	207	+	0.6423	0.6159	.3946626	0.9553	
var104	207	+	0.6112	0.5818	.394887	0.9555	
var105	207	+	0.6080	0.5793	.3955778	0.9555	
var106	207	+	0.5274	0.4921	.3974963	0.9561	
var107	207	+	0.6255	0.6008	.3971921	0.9554	
var108	207	+	0.6417	0.6173	.3962586	0.9553	
var109	207	+	0.6210	0.5928	.3950028	0.9554	
var110	207	+	0.6915	0.6693	.3940456	0.9550	
var111	207	+	0.4287	0.3929	.4029759	0.9566	
var112	207	+	0.6032	0.5762	.3971337	0.9555	
feb_mssq_end	207	+	0.5878	0.5564	.3953951	0.9557	
Test scale					.3968646	0.9565	mean(unstandardized items)

(b) After Distance Learning (May)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem cov.	alpha	Label
may_mssq_s~t	207	+	0.6192	0.5987	.478762	0.9653	
var115	207	+	0.5983	0.5760	.478752	0.9654	
var116	207	+	0.6822	0.6635	.4757161	0.9650	
var117	207	+	0.6890	0.6698	.4744884	0.9649	
var118	207	+	0.6039	0.5797	.4767246	0.9653	
var119	207	+	0.6762	0.6559	.4744039	0.9650	
var120	207	+	0.7100	0.6908	.4723957	0.9648	
var121	207	+	0.6433	0.6193	.4736816	0.9652	
var122	207	+	0.6745	0.6538	.4741187	0.9650	
var123	207	+	0.6990	0.6788	.4721887	0.9649	
var124	207	+	0.7718	0.7568	.4710293	0.9646	
var125	207	+	0.6621	0.6414	.4752867	0.9651	
var126	207	+	0.6861	0.6663	.4740298	0.9650	
var127	207	+	0.7120	0.6926	.4718204	0.9648	
var128	207	+	0.7327	0.7126	.4685069	0.9647	
var129	207	+	0.7153	0.6964	.4721373	0.9648	
var130	207	+	0.6801	0.6593	.4734787	0.9650	
var131	207	+	0.5728	0.5465	.4773968	0.9655	
var132	207	+	0.6161	0.5937	.4773626	0.9653	
var133	207	+	0.6170	0.5933	.4761595	0.9653	
var134	207	+	0.5819	0.5560	.4770683	0.9655	
var135	207	+	0.6813	0.6618	.4748588	0.9650	
var136	207	+	0.6766	0.6562	.4742104	0.9650	
var137	207	+	0.5426	0.5121	.4767197	0.9657	
var138	207	+	0.6657	0.6434	.4732525	0.9651	
var139	207	+	0.6634	0.6403	.4726347	0.9651	
var140	207	+	0.6752	0.6513	.470618	0.9650	
var141	207	+	0.6319	0.6053	.4723462	0.9653	
var142	207	+	0.6673	0.6427	.4707251	0.9651	
var143	207	+	0.7528	0.7343	.4680753	0.9646	
var144	207	+	0.6677	0.6421	.4696799	0.9651	
var145	207	+	0.6201	0.5929	.4729128	0.9653	
var146	207	+	0.4864	0.4531	.478943	0.9660	
var147	207	+	0.6929	0.6750	.4757228	0.9650	
var148	207	+	0.7066	0.6872	.4724382	0.9649	
var149	207	+	0.7093	0.6896	.4718221	0.9648	
var150	207	+	0.7419	0.7245	.4712853	0.9647	
var151	207	+	0.4709	0.4399	.4811193	0.9660	
var152	207	+	0.6225	0.5976	.4746775	0.9653	
may_mssq_end	207	+	0.7024	0.6801	.4694002	0.9649	
Test scale					.4739237	0.9659	mean(unstandardized items)

Supplementary Figure 2. *Validity and Reliabity of Depression, Anxiety, Stress Scale-21 (DASS-21). (a) Before Distance Learning (February) and (b) After Distance Learning (May).*

Pearson product moment validity test showed a statistically significant (P<0.05) item-total correlation for stress scale (item no. 1,6,8,11,12,14,18) ranging from 0.44 to 0.79 confirming the good discrimination of each question and the suitability of DASS-21 for measuring and obtaining distress data from respondents in this study. Cronbach's Alpha reliability test also showed significance value more than 0.90confirming the internal consistency of DASS-21 when used repeatedly.

(a) Before Distance Learning (February)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem cov.	alpha	Label
feb_dass_s~t	207	+	0.7860	0.7573	.2712945	0.9421	
var179	207	+	0.4075	0.3412	.2876714	0.9488	
var180	207	+	0.6944	0.6606	.2785281	0.9436	
var181	207	+	0.6133	0.5795	.2851023	0.9448	
var182	207	+	0.6506	0.5962	.2716498	0.9451	
var183	207	+	0.6868	0.6441	.2737265	0.9438	
var184	207	+	0.6581	0.6244	.2818127	0.9441	
var185	207	+	0.8167	0.7891	.2668619	0.9414	
var186	207	+	0.7779	0.7416	.2656226	0.9423	
var187	207	+	0.6981	0.6616	.2763492	0.9435	
var188	207	+	0.7738	0.7487	.2764644	0.9425	
var189	207	+	0.7623	0.7292	.27078	0.9424	
var190	207	+	0.7789	0.7524	.2744491	0.9423	
var191	207	+	0.7459	0.7137	.2738713	0.9427	
var192	207	+	0.7235	0.6878	.2739991	0.9431	
var193	207	+	0.7208	0.6876	.2761864	0.9432	
var194	207	+	0.6981	0.6620	.2766592	0.9435	
var195	207	+	0.6098	0.5642	.2797378	0.9449	
var196	207	+	0.6627	0.6217	.2772438	0.9441	
var197	207	+	0.7591	0.7286	.2735521	0.9425	
feb_dass_end	207	+	0.6525	0.6113	.2781051	0.9442	
Test scale					.2756985	0.9461	mean(unstandardized items)

(b) After Distance Learning (May)

Item	Obs	Sign	item-test corr.	item-rest corr.	interitem cov.	alpha	Label
may_dass_s~t	207	+	0.6052	0.5458	.2046121	0.9144	
var155	207	+	0.4836	0.4095	.2094379	0.9179	
var156	207	+	0.7014	0.6653	.206087	0.9121	
var157	207	+	0.4676	0.4229	.216197	0.9165	
var158	207	+	0.5403	0.4754	.2077189	0.9160	
var159	207	+	0.6744	0.6248	.2022645	0.9125	
var160	207	+	0.3810	0.3236	.2173698	0.9183	
var161	207	+	0.6455	0.5922	.2033828	0.9132	
var162	207	+	0.7166	0.6667	.1978557	0.9114	
var163	207	+	0.6511	0.6081	.206903	0.9130	
var164	207	+	0.6320	0.5881	.2079165	0.9135	
var165	207	+	0.6636	0.6167	.2043681	0.9127	
var166	207	+	0.7656	0.7294	.1995415	0.9101	
var167	207	+	0.6716	0.6259	.2041789	0.9125	
var168	207	+	0.7175	0.6786	.2032454	0.9115	
var169	207	+	0.5875	0.5380	.2089099	0.9144	
var170	207	+	0.6671	0.6184	.2032976	0.9126	
var171	207	+	0.5167	0.4413	.2070385	0.9174	
var172	207	+	0.6556	0.6090	.2050805	0.9129	
var173	207	+	0.6847	0.6462	.2062828	0.9124	
may_dass_end	207	+	0.5519	0.5033	.2112769	0.9151	
Test scale					.2063317	0.9176	mean(unstandardized items)